

REMARKS

Claims 1-20 are pending in this application.

In the Office Action, the Examiner objected to the specification and claims 7 and 17 for using the term “conductive past” and suggested changing the term to “conductive paste”. Applicant thanks the Examiner for pointing out an obvious typographical error. The specification and the claims have been amended according to the Examiner’s suggestion.

The Examiner rejected claims 1-5, 9-15, 19 and 20 under 35 U.S.C. Section 102(e) as being anticipated by Takahashi (US Patent No. 6655790). Applicant traverses the rejection.

Generally, the present invention concerns an ink-jet printing head, an example of which is shown in FIG. 5 of the present specification. The printing head includes an actuator 20 and a cavity unit 10. An active portion of the actuator 20 pushes ink in an ink pressure chamber 16. The ink then ejects out of the nozzle 54. The actuator 20 includes a group of piezoelectric ceramic sheets on which drive electrodes and common electrodes are formed in an alternating manner.

Conventionally, the drive electrodes are positioned on top of the lowest piezoelectric sheet that faces the cavity unit 10 and a common electrode is disposed on the second lowest sheet on top of the drive electrodes. With this configuration, when voltage is applied to a certain drive electrode, electric current flows through the lowest piezoelectric sheet, the cavity unit and the ink to an adjacent drive electrode corresponding to an adjacent pressure chamber. This gives rise to unstable ejection of ink in the intended nozzle and an unintended ejection of ink through an adjacent unintended nozzle.

According to the present invention, this problem is solved by (1) positioning one common electrode on the lowest piezoelectric sheet of the actuator unit, and (2) shaping the common electrode in such a way that the contours of all the drive electrodes fall within a contour of that common electrode. An example of this is shown in FIGS. 8 and 9. The common electrode 25 has a set of protrusions 25b that extend from the middle portion to cover the corresponding electrodes and their extensions 24a.

With this feature, polarization does not occur between the common electrode 25 on the lowest piezoelectric sheet and the cavity plate during the polarization step in manufacturing the printhead. This stabilizes the polarization of other piezoelectric sheets. This feature (resulting in lack of a polarization area under the common electrode 25) also

prevents undesirable static electricity from being generated between the common electrode 25 and the cavity unit 10 through the ink. Moreover, it is not necessary to connect the cavity unit 10 to ground with an electrically conducting material in order to remove any induced voltage. Therefore, the manufacturing process can be simplified (see page 18, line 9 – page 19, line 14).

This feature is recited in claim 1 as “projected contours of all the drive electrodes fall within a **projected contour of one of the common electrodes disposed closest to the cavity unit** with respect to the stacked direction” (emphasis added).

The Examiner stated that the above recited feature is disclosed in Takahashi in FIGS 1 and 9) and points to element 2 in FIG. 9 as disclosing the common electrode as recited in claim 1. Applicant respectfully disagrees.

First, claim 1 recites a “plurality of common electrodes” and the lowest positioned common electrode is just “one of the common electrodes”. See, for example, FIG. 11 that shows at least four common electrodes 25 stacked in an alternating manner with drive electrodes 24. This results in many active portions in the stacked direction. By contrast, Takahashi has only a single active portion sandwiched by the drive electrode and the common electrode for one pressure chamber in the stacked direction of the sheet members.

Second, in claim 1, the plurality of drive electrodes and the plurality of common electrodes are arranged in alternation with respect to the stacked direction. On the other hand, in Takahashi, a single common electrode 2 and a single drive electrode 3 are provided on one and the other surfaces of the stacked sheets, respectively, in the stacked direction thereof. It should be noted that internal electrodes 11a and 12a of Takahashi are not for ejecting an ink droplet but for polarizing the stacked piezoelectric sheets during manufacture.

Moreover, in claim 1, the closest common electrode to the cavity unit is covered with a piezoelectric sheet in the actuator, which prevents the common electrode from contacting ink in the pressure chambers. On the other hand, Takahashi has the common electrode 2 positioned on the bottom surface of the actuator unit. According to this structure of Takahashi, ink in the pressure chambers may contact the closest common electrode, thereby corroding that electrode.

Accordingly, Takahashi does not teach or suggest the novel combination as claimed in claim 1.

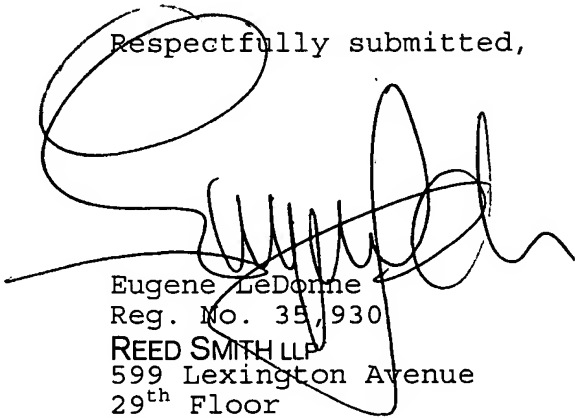
Applicant submits that dependent claims 2-5, 9-15, 19 and 20 are also patentable by virtue of their dependency from independent claim 1.

The Examiner rejected remaining claims 6-8 under 35 U.S.C. Section 103(a) as being obvious over Takahashi in view of Shimada (US Patent No. 6378996). Further, the Examiner rejected claim 16 under 35 U.S.C. Section 103(a) as being obvious over Takahashi in view of Moynihan (US Patent No. 5605659). The Examiner also rejected claim 17 under 35 U.S.C. Section 103(a) as being obvious over Takahashi in view of Utsumi (US Patent No. 4766671). Applicant respectfully submits that claims 6-8 and 16-17 are patentable by virtue of their dependency from independent claim 1.

Applicant has added claims 21 and 22. Claim 21 defines the positional relationship between the cavity unit and the closest common electrode to the cavity unit. Claim 22 states that the projected contours of all the drive electrodes partially overlap the projected contour of the closest common electrode to the cavity unit in the stacked direction. No new matter is added.

Based upon the above amendments and remarks, Applicant respectfully requests reconsideration of this application and its earlier allowance. Should the Examiner feel that a telephone conference with Applicant's attorney would expedite the prosecution of this application, the Examiner is urged to contact him at the number indicated below.

Respectfully submitted,



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